Dynamical Adaptation in ORNs

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Does Spike Frequency Adaptation imply Dynamical Adaptation?

Liu and Wang's (papers2://publication/uuid/54F8985C-DC25-42D9-AD8B-805EBCD7475F) model of spike frequency adaptation shows some qualitative similarity to ORN response dynamics. Can the mechanics of spike frequency adaptation also give rise to a phenomenon like fast dynamical adaptation?

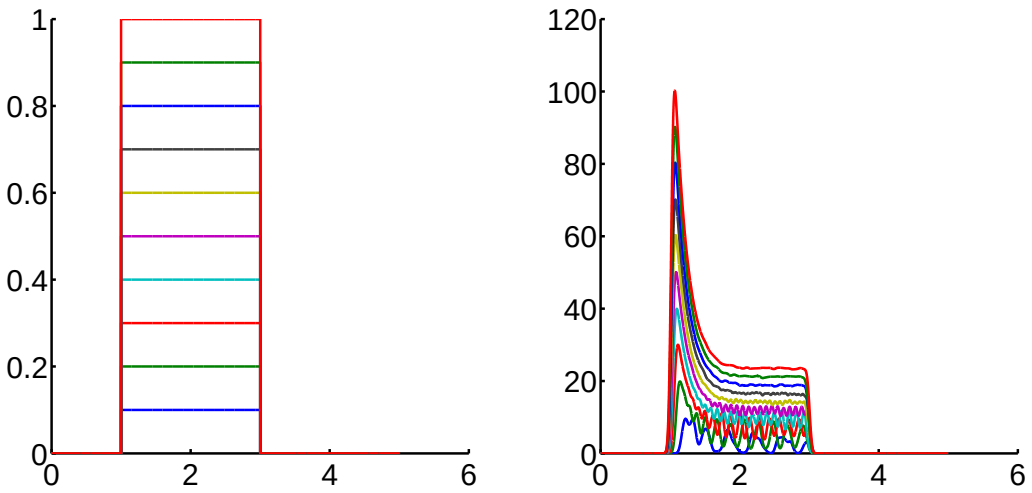
Contents

Response properties of Model Neuron

In this plot, a Liu-Wang model neuron is simulated using parameters very close to what they use in the paper. The parameters are:

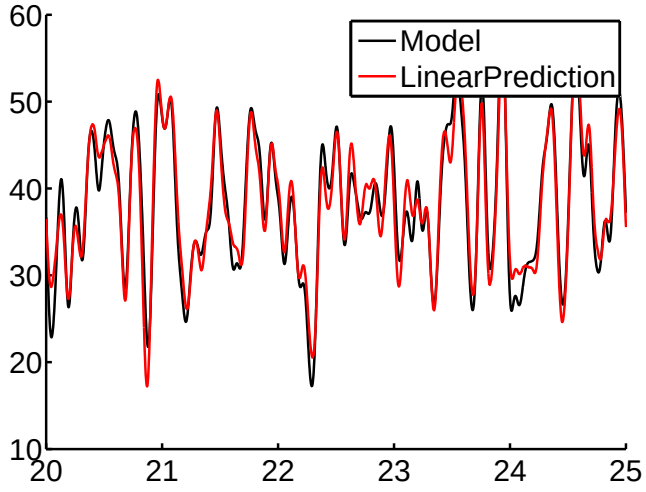
```
     Cm: 0.5000
     gL: 0.0250
 tau_Ca: 1
      C: 0.3800
   gAHP: 1.3500
 Vreset: -60
    Vth: -55
  Vrest: -70
      A: 666
     Vk: -80
```

The figure below shows the response of this model neuron to increasing pulses of stimulus.



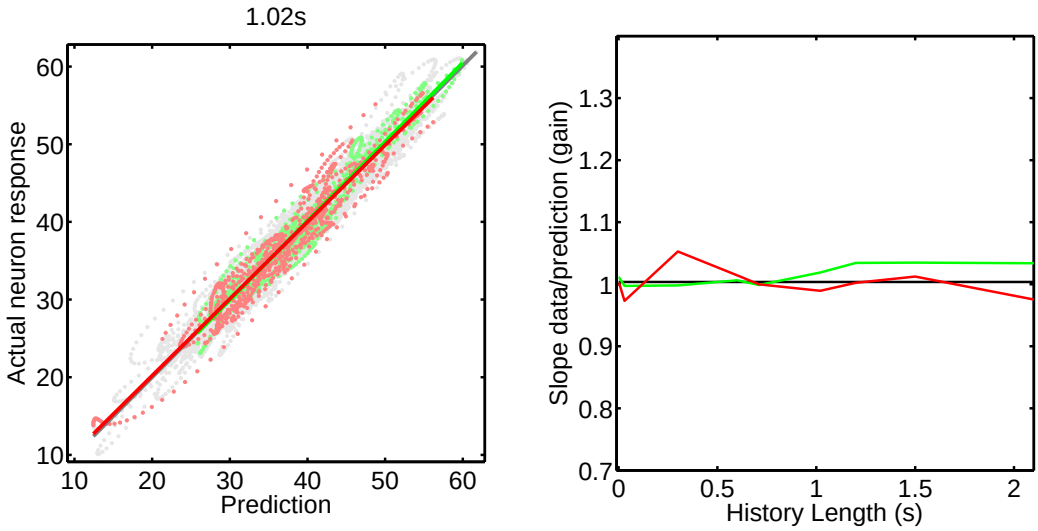
Response to exponentiated Gaussian stimuli

Now we simulate some flickering stimuli by exponentiated Gaussian noise and use that to feed the neuron. The following figure shows the output of the model neuron, together with a linear fit to the model output.



Does this show the signature of fast adaptation?

Does the (feedback) mechanism of spike frequency adaptation allow the neuron to modulate its gain on a fast time scale, like in real ORNs? We perform a linear gain analysis as before.


1.02s
Actual neuron response
Prediction
10
20
30
40
50
60
Slope data/prediction (gain)
History Length (s)
0.7
0.8
0.9
1
1.1
1.2
1.3
0
0.5
1
1.5
2